

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
4 March 2004 (04.03.2004)

PCT

(10) International Publication Number
WO 2004/018774 A1

(51) International Patent Classification⁷: **E01C 23/06**,
23/14

(21) International Application Number:
PCT/EP2003/009144

(22) International Filing Date: 14 August 2003 (14.08.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0219088.2 16 August 2002 (16.08.2002) GB

(71) Applicant (*for all designated States except US*): **ROADS EUROPE LTD** [GB/GB]; Old Acres, The Slype, Gustard Wood, Wheathampstead, Herts, AL4 8RZ (GB).

(72) Inventor; and

(75) Inventor/Applicant (*for US only*): **JONES, Mark, Richard** [GB/GB]; Ranby House, Ranby, Nr. Market Raisen, Lincs LN9 5LN (GB).

(74) Agent: **BAWDEN, Peter, Charles**; Bawden & Associates, 4 The Gatehouse, 2 High Street, Harpenden, Herts, AL5 2TH (GB).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

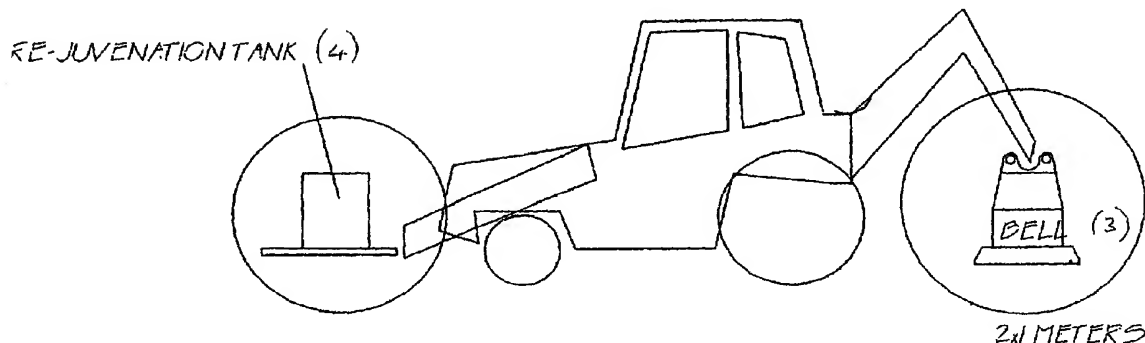
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: IMPROVED ROAD REPAIR SYSTEMS



(57) Abstract: A range of various sized attachments of infrared heaters powered by liquid petroleum gas (LPG) for installation to a number of different styles of vehicles. These infrared heaters are designed to heat asphalt and other road and structure surfaces for subsequent repair. The vehicles may be an adaptation to existing designs of medium to heavy road going flat bed trucks or to various types of construction loaders. The attachments to construction loaders may be installed as adaptations to front end loader quick-change systems or back hoe bucket mount positions. The whole attachment and its support operating and control assembly may be easily removed for addition to other vehicles of similar types. With the area heated to an appropriate temperature to release the bound surface structure it can then be raked and combined with minimal amounts of new surface fill if required to the previously damaged area. A rejuvenating liquid is then sprayed onto the mix, prior to compaction to provide a fast, economic, quiet and more environmentally friendly means of road repair than traditional methodology.

WO 2004/018774 A1

IMPROVED ROAD REPAIR SYSTEMS

The present invention relates to asphalt repair systems and in particular to systems useful in the repair of roads.

5

Asphalt deteriorates because of oxidation and the constant pounding of traffic, but it is the joints from old repairs that become the Achilles heel as weather and water ingress and break up the seal and adjacent asphalt. Considerable sums of money are spent each year on routine maintenance and repair of carriages and footways, and the utility companies also spend large sums making effective repairs after their excavations. Furthermore, roads are generally deteriorating.

10

15

Bituminous wearing courses such as asphalt are generally composed of about 94% aggregate (gravel or sand) and about 6% bitumen binder. The bitumen binder is composed of hydrocarbons and has ionic properties, which serve to bind the sand and gravel particles together.

20

Wearing courses deteriorate through oxidation of the bituminous binder. The oxidation process reduces the ionic properties of the bitumen, which in turn leads to release of the aggregate. The oxidised binder loses its flexibility and the surface shrinks and cracks. The effects of traffic and weather (temperature changes and moisture) speed up this process. After general release of material larger flaws appear which eventually turn into potholes.

25

The oxidisation process accelerates other damage to the wearing course and failure of joints especially from conventional reinstatements, around ironwork and on trenchwork.

30

The traditional method for the repair of damaged or aged asphalt and tarmacadam-wearing courses comprises the total removal of an area and its replacement with new asphalt. The damaged area and its surrounds may be removed by using noisy pneumatic or hydraulic hand held or machine mounted breakers. In this traditional method it is necessary to use expensive and very noisy diamond saws to pre-cut the area to minimise additional damage and to form a face to bond in the replacement material. The areas may also be removed by more modern methods known as cold planing that pulverizes the damaged asphalt.

35

The area is then filled with new material that then needs to be compacted and sealed with overbanding or jointing sealant. The removed asphalt is then transported away for disposal that is normally for land-fill due to the limitations of current re-cycling systems.

CONFIRMATION COPY

These conventional methods are not ideal in respect of costs, safety, environment, sustainability and durability. Such methods are described in United States Patent 4534674 and German Patent application 3906352 A1.

5

More recently Hot In-Place Recycling (HIR) techniques have been developed for the effective repair of potholes, cracks and sunken utility cuts in asphalt surfaces using an infrared heating process. With the surface heated and raked it is then combined with a rejuvenation liquid that will recycle the existing embrittled asphalt. This enables a substantial reduction in repair costs. A typical rejuvenating liquid for use in the method generally comprises maltenes. Preferred liquids contain an emulsifier, a heavy paraffinic distillate solvent extract, a heavy naphthenic distillate solvent extract and water and is described in WO00/20689 optionally with other additives.

10

15 The Infrared HIR method comprises: heating the damaged area with an infrared heating device; adding new material if required; raking together; applying a liquid that rejuvenates the original bitumen; and compacting the new combined material.

20 The HIR method can also include applying a topcoating liquid to the repaired area that seals and binds the repair, or applying a fine aggregate to provide skid resistance.

The present invention provides improved equipment for performing the Infrared HIR techniques described above, comprising a single vehicle road repair system with means for supplying infrared heat to the surface to be repaired, means for storing and supplying hot new asphalt, means for storing and supplying a rejuvenation liquid, and means for storage and supply of gas for heating.

25

In a first embodiment the vehicle may be a truck, fitted at the rear with an infrared heater system that is adapted to be moved towards and away from the surface to be repaired. The flatbed would have fitted a hot box that contains replacement asphalt if required, an adjacent tank containing rejuvenation liquid which may use the hotbox residual heat to maintain a good working temperature, and preferably a pump and lance for delivery of the liquid to the desired location. In a preferred embodiment a small waste container may be provided. A secure area is preferably provided for hand tools and other equipment such as traffic control signs, rakes and equipment. A tow bar may be fitted for towing a trailer-mounted compaction roller.

30

35

In a preferred embodiment the infrared heating system is hinged so that it may be folded up against the back of the truck when not in use. It is further preferred that the heater be fitted with a cover to protect the otherwise exposed heating surface.

- 5 Advantages over an existing vehicle such as the vehicles manufactured by Ray-Tech Infrared Corp., as shown on their web site, are:
1. Built in tank, pump and delivery system, such as a spray lance for storage and application of rejuvenation liquid.
 2. A tow bar for a trailer-mounted compaction roller and a built in gas tank so avoiding
10 the need for a hydraulic lifting arm to load and unload the roller and large gas bottles.
 3. A secure enclosed area, for loose tools and equipment, typically secured by a lockable sliding curtain securing the front half of the vehicle's flatbed.

15 In a further preferment the heater blanket is made of Fecralloy® which heats quickly and cools to ambient in less than 5 seconds, providing significant safety advantages. The blanket, whether of Fecralloy® or another suitable material may be heated using LPG supplied through a vaporiser system.

20 In another embodiment the vehicle may be a tractor backhoe or wheeled or skid-steer loader to which the equipment may be quickly installed or removed. The attachment that forms the infrared heater being fixed to the dipper arm (of a backhoe loader) or the front loader quick change system (of a skid steer) so that it may be moved towards and away from the surface to be repaired. This attachment can also contain the associated gas bottles and control systems. These control systems are preferably such that they enable independent on/off
25 control of each burner within the heater. A separate attachment may be fitted to the rear of the vehicle containing a hot box for new asphalt, an adjoining tank for rejuvenation liquid that uses the hotbox residual heat to maintain a good working temperature, and a spray lance for its application to the raked area. With this system the area to be repaired may be heated with the vehicle which is then moved quickly away to a suitable position, the heated area is
30 then raked so that the rejuvenating liquid may be delivered to the prepared surface of the area being repaired, prior to compaction.

Such attachments for tractor backhoe vehicles are a part of the present invention.

35 The advantages of this invention when used in a skid-steer solution over existing skid-steer attachments manufactured by Ray-Tech Infrared Corp. are:

1. Built in tank, pump and spray lance for storage and controlled application of warm rejuvenation liquid.
2. Built in hotbox to enable independence from a separate supply of hot asphalt when operating.
- 5 3. In a preferred system the heater incorporates a more robust heater blanket of Fecralloy® which heats quickly and cools to ambient in less than 5 seconds. This provides significant safety advantages.

10 The invention therefore provides more efficient, compact and lightweight equipment that enables faster, quieter and more economic method of repair of a wearing course using Infrared HIR techniques.

15 The heating of the damaged area to be repaired may be carried out using one or more LPG powered infrared heaters depending on the size and shape of the area to be repaired. The heating needs may be to depths of 10 mm to 100 mm from the surface. The average temperature of the heated material should generally not exceed 200°C and may be from 50 to 200°C, preferably 100 to 200°C. As with all carbon structures heat increases oxidation, but since the infrared output of the infrared attachment is selective at its medium wave output it does not induce burning (which would destroy the binder's asphaltenes permanently). The heating time may vary according to its structure and dependant upon the surface temperature, wind chill factor and whether the surface is damp, but may for example be from 5 to 20 minutes, typically 6 to 8 minutes.

25 Once heated, the damaged area is raked or scarified to mix the highly oxidised top surface with the less oxidised sub-strata. This also increases the surface area of the mix. Care must be taken to leave an outer perimeter of the heated area unraked to allow development of an efficient bonded joint when compacted.

30 The rejuvenating liquid may then be applied using the lance provided. The composition of the rejuvenating liquid comprises rejuvenating oils high in aromatics with high levels of polar compounds. The oils in the rejuvenating liquid are preferably emulsified with cationic slow set emulsifiers at higher than normal levels to ensure not only a very storable and stable emulsion but also to aid in a slow cure and break time.

35 The rejuvenating liquid preferably contains from 30 to 80 parts by weight in total of a heavy paraffin distillation solvent extract and a heavy naphthenic distillate solvent extract, from 10 to 60 parts by weight of water, and from 1 to 5 parts by weight of the emulsifier. More

preferably, the liquid comprises from 60 to 65 parts by weight in total of the heavy paraffinic distillate solvent extract and the heavy naphthenic distillate solvent extract, from 30 to 35 parts by weight of water and from 1 to 5 parts by weight of the emulsifier.

- 5 New material may be needed if it is required to level the patch to be repaired, i.e., the amount of material that has been worn out of the surface. The material may also assist in knitting of the joint. On hot rolled asphalt, precoated chippings are added and compacted into the surface to give road texture. The material is generally raked level and then compacted either by a vibrating roller or compaction plate. A topcoat of a sealer/binder may
10 also be applied, or a dusting of fine aggregate (e.g. aluminium silicate) may be added to ensure good initial skid resistance. Once the surface has cooled and hardened, normally for a minimum of one hour, it is capable of accepting traffic.

The advantages to using the apparatus of the present invention over traditional methods are:

15

1. Reduced asphalt costs since only material lost as a result of the damage is added: in the conventional method it is also necessary to replace material that is removed from around and beneath the damaged area. Substantial cost savings arise due to avoiding the need to transport the removed asphalt to land fill with its additional
20 charges.

20

2. The resulting repair is fully bonded with the existing material by means of heat fusion. This eliminates or reduces the problems of joint failures and the problem of 'cold shock' that occurs in the conventional method when hot sealant or new material
25 is added to cold asphalt to join the new material to the old material. There is no pre-cutting of an edge to the old surface, no need for any kind of overbanding or joint sealing (notoriously short-lived), and no mixing of materials with different expansion and contraction rates next to each other. Furthermore, when the application of the topcoating is included in the method of the invention, the surface is further bonded.

30

3. By recycling the existing surface there is far less new material used, the process is very quiet, and its speed enables the roads to be opened up far more quickly than would normally be the case. Due to the lack of noise, roads may be repaired at night while traffic is at its lightest with less disturbance to residents.

35

4. This method of repair also eliminates the problems of 'white finger' caused by pneumatic and hydraulic hand held breakers, which is a major problem to the construction industry, causing added costs to all concerned.

5 5. Some 94% of the wearing course is rock or sand and has an extremely long lifetime of many decades. Of the 6% of the wearing course that is binder, only a small fraction is degraded and the remainder (the predominant compounds being asphaltenes) has a very long life span. By replacing only the fraction of the aromatic oil component that is lost, the total combined method of the invention is highly efficient in material terms, and as a result effectively recreates the hydrocarbon chain.

The invention is illustrated by reference to the accompanying drawings in which:

15 Figure 1 shows an apparatus consisting of a vehicle 1 to which is attached a hot box 2 at the front of the vehicle and at the back there is a dipper arm to which is attached a bank of infrared heaters 3 in a manner that may be moved up and down towards the road surface to heat the areas to be repaired.

20 Figure 2 shows the composition of the hot box used in Figure 1 showing compartments 4 and 5 for the rejuvenating liquid and a pipe 6, connected at one end to a pump 7 and at the other end to a lance 8 to provide the delivery system for the rejuvenating liquid.

25 Figure 3 shows the attachment to the dipper arm 9 of the vehicle of Figure 1 on which are mounted the infrared heaters 10. The attachment is also provided with an ON/OFF Sensor 11 so that the heating can be controlled by the proximity to the road surface.

30 Figure 4 shows a truck 12 according to the present invention provided at the back with a bank of infrared heaters 13 which are hinged so that they can be stored against the back of the truck when not in use as shown in Figure 4. The truck is also provided with hot box and compartment 14 for the rejuvenating liquid and a pump 15, pipe 16 and lance 17 for delivery of the liquid. The truck may also be provided with other compartments for example those shown at 18 and 19 for the storage of other useful equipment.

35 Figure 5 is a plan view of the truck of Figure 4 showing the bank of infrared heaters moved downwards to be parallel to the road in their operating mode.

Figure 6 is a plan view of a preferred burner system which may be used with the apparatus shown in Figures 1 to 3. Figure 6 shows two pairs of burners 20 and 21 mounted in an angle frame which is preferably of steel. Four gas bottles 22 to 25 are located within the assembly and the complete assembly is suspended from a central column 26.

5

Figure 7 is a side view showing how the gas bottles may be mounted and held securely within the supporting frame 27 by stirrups 28 and 29 which may conveniently be of the type used for cargo restraint.

10 Figure 8 shows how doors 30 and 31 may be provided (shown in the open position in Figure 8) for safety and security purposes. Figure 8 also shows in more detail the central column which may be used to suspend the heater assembly including a spherical plain thrust bearing 32 which is tensioned with a compression spring 33 which can act as a shock absorber.

15

In the operation of both systems illustrated, the damaged area to be repaired is heated by the infrared system attached to the vehicle, after which the area is then raked. The pump may then be activated to deliver the rejuvenating liquid. The mix of heated original asphalt plus new material if required may then be further raked before being compacted by a
20 vibrating roller or compaction plate. Once leveled to the original surface profile it is ready to accept traffic.

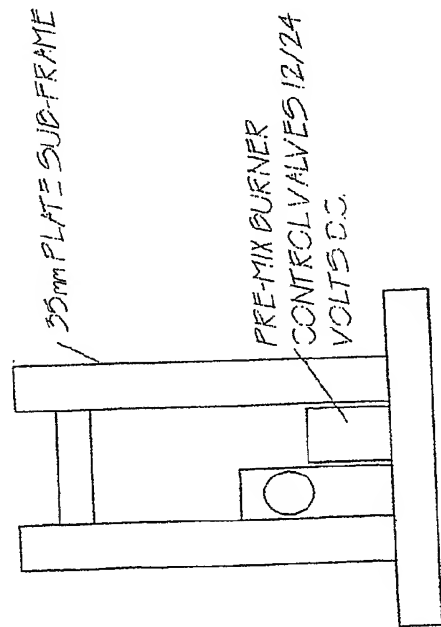
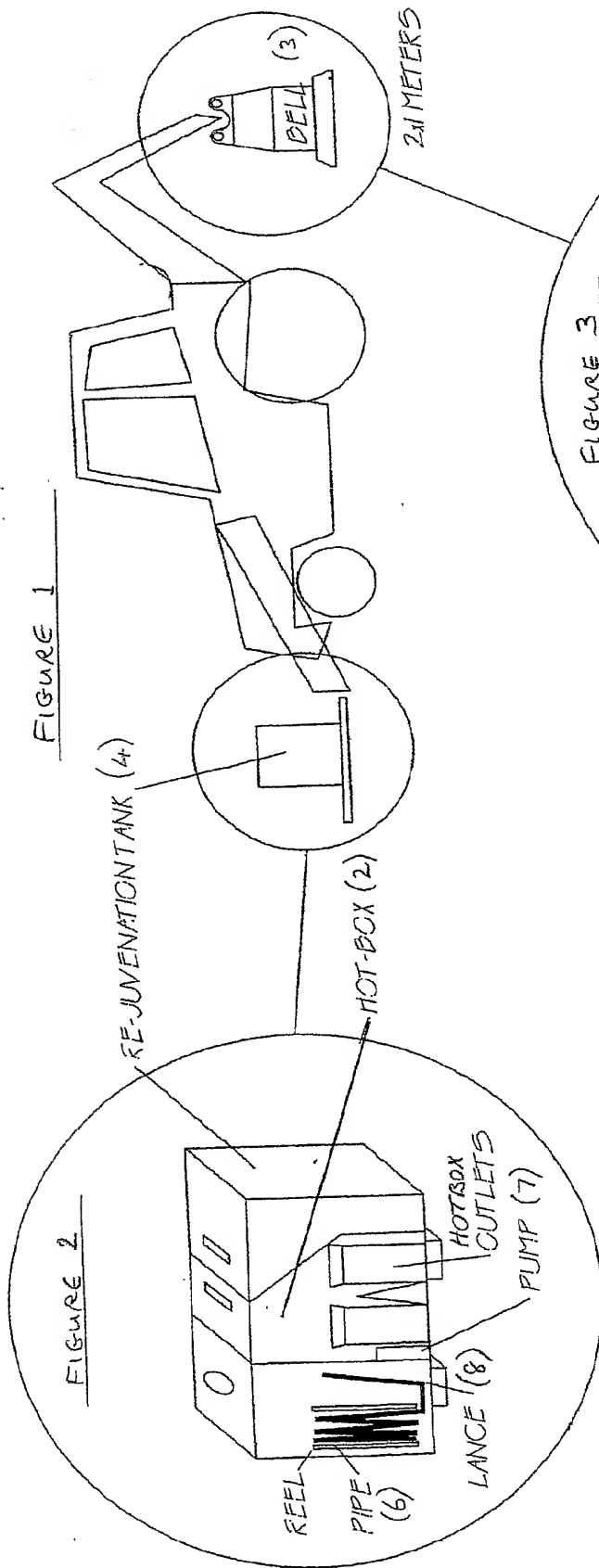
CLAIMS

1. Equipment for the repair of asphalt surfaces comprising a single vehicle road repair system with means for supplying infrared heat to the surface to be repaired, means for
5 storing and supplying hot new asphalt, means for storing and supplying a rejuvenation liquid, and means for storage and supply of gas for heating.
2. Equipment according to Claim 1, in which the single vehicle is a truck.
- 10 3. Equipment according to Claim 2, in which the truck is fitted at the rear with an infrared heater system that is adapted to be moved towards and away from the surface to be repaired.
4. Equipment according to any of the preceding Claims fitted with a hot box that contains
15 replacement asphalt.
5. Equipment according to Claim 4 also containing an adjacent tank for rejuvenation liquid wherein the hotbox residual heat is used to maintain the working temperature of the rejuvenation liquid.
20
6. Equipment according to any of the preceding Claims, in which the means for supplying the rejuvenation liquid comprises a pump and lance.
7. Equipment according to any of the preceding Claims, provided with a tow bar for towing
25 a trailer-mounted compaction roller.
8. Equipment according to any of the preceding Claims in which the infrared heating system is hinged so that it may be folded up against the back of the truck.
- 30 9. Equipment according to Claim 1, in which the vehicle is a tractor backhoe or wheeled or skid-steer loader.
10. Equipment according to Claim 9 in which the attachment that forms the infrared heater is fixed to the dipper arm (of a backhoe loader) or the front loader quick change system (of
35 a skid steer) so that it may be moved towards and away from the surface to be repaired.

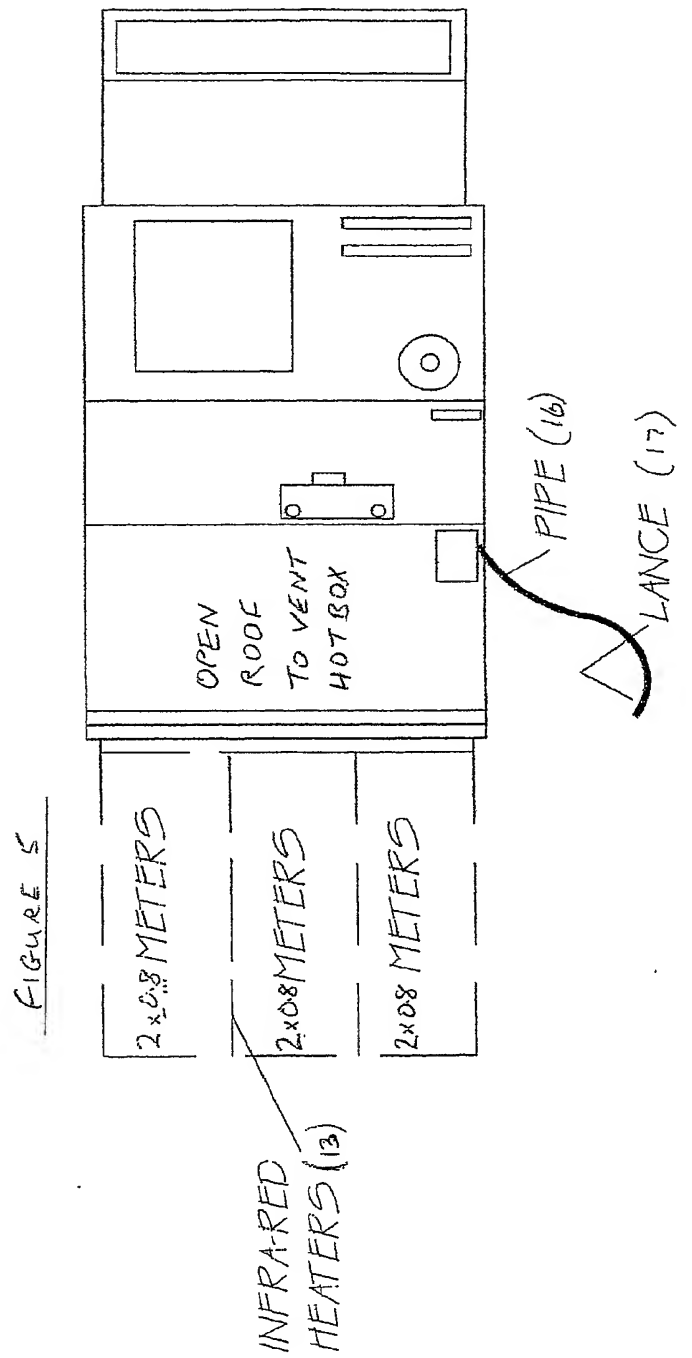
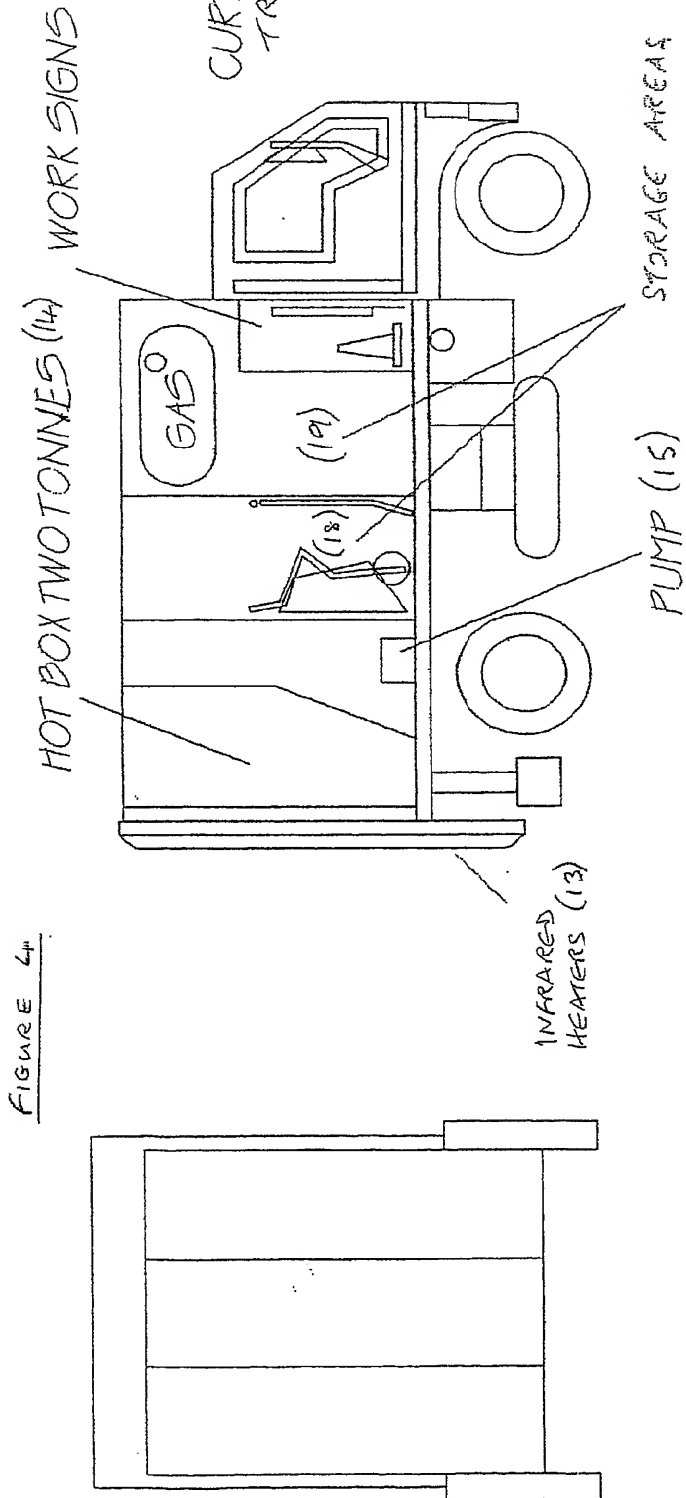
11. Equipment according to Claim 10, in which the attachment contains the associated gas bottles and control systems.
- 5 12. Equipment according to Claim 10 or Claim 11, provided with an attachment fitted to the rear of the vehicle containing a hot box for new asphalt, an adjoining tank for rejuvenation liquid that uses the hotbox residual heat to maintain a good working temperature, and a spray lance for its application to the raked area.
- 10 13. Equipment according to any of the preceding Claims provided with a control system for the heater.
14. Equipment according to Claim 13 in which the control system enables independent on/off control of each burner or set of burners within the heater.
- 15 15. Equipment according to any of the preceding Claims in which the heater blanket is made of Fecralloy®.
16. A process for repairing damaged asphalt in which the damaged area to be repaired is heated using one or more LPG powered infrared heaters to a depth of 10 mm to 100 mm
20 from the surface wherein the average heating temperature is from 50 to 200°C, and the heating is for from 5 to 20 minutes, once heated, the damaged area is raked and/or scarified, the rejuvenating liquid comprising emulsified oils high in aromatics with high levels of polar compounds is then applied to the raked and/or scarified area, the surface is then compacted and allowed to cool and harden for at least one hour.
- 25 17. A process according to Claim 16 in which the rejuvenating liquid contains from 30 to 80 parts by weight in total of a heavy paraffin distillation solvent extract and a heavy naphthenic distillate solvent extract, from 10 to 60 parts by weight of water, and from 1 to 5 parts by weight of the emulsifier.
- 30 18. A process according to Claim 16 or Claim 17 in which precoated chippings are added on hot rolled asphalt and compacted into the surface to give road texture.
- 35 19. A process according to any of Claims 16 to 18 in which a topcoat of a sealer/binder is also applied.

20. A process according to any of Claims 16 to 19 in which a dusting of fine aggregate is added to ensure good initial skid resistance.

FIGURE 1



PAREBA185



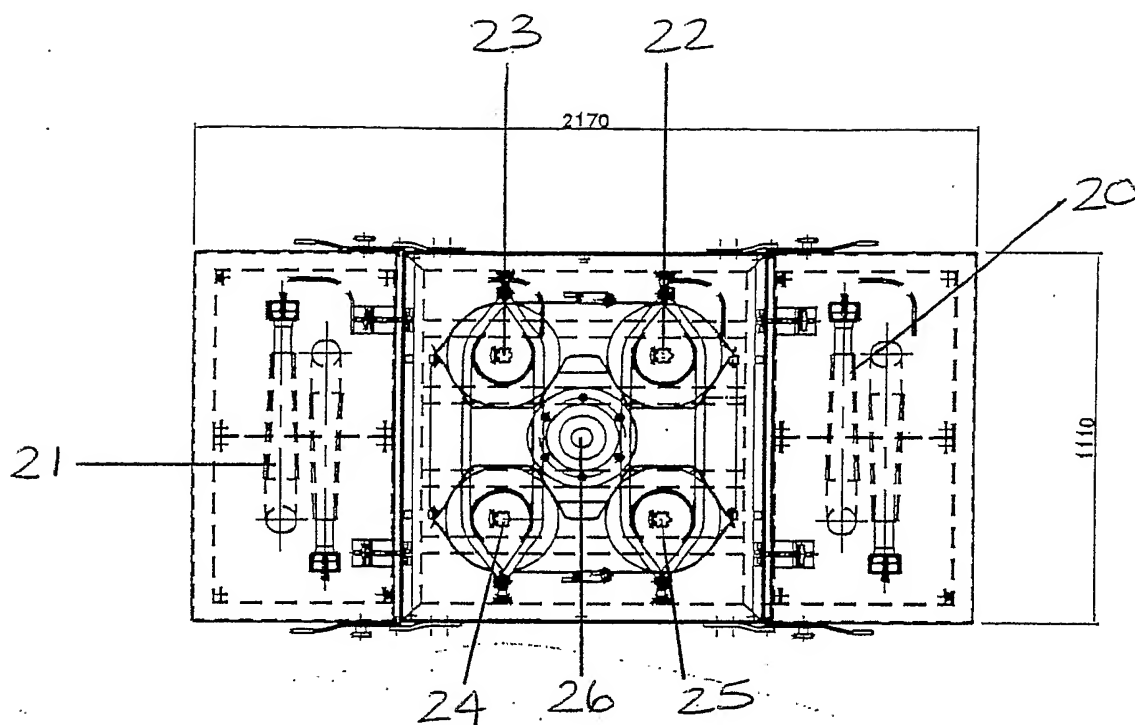


Figure 6

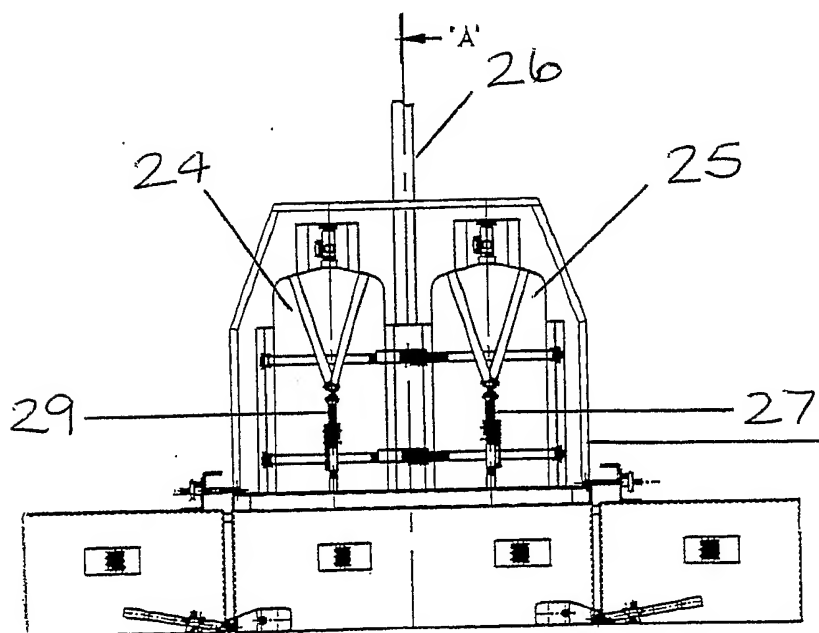


Figure 7

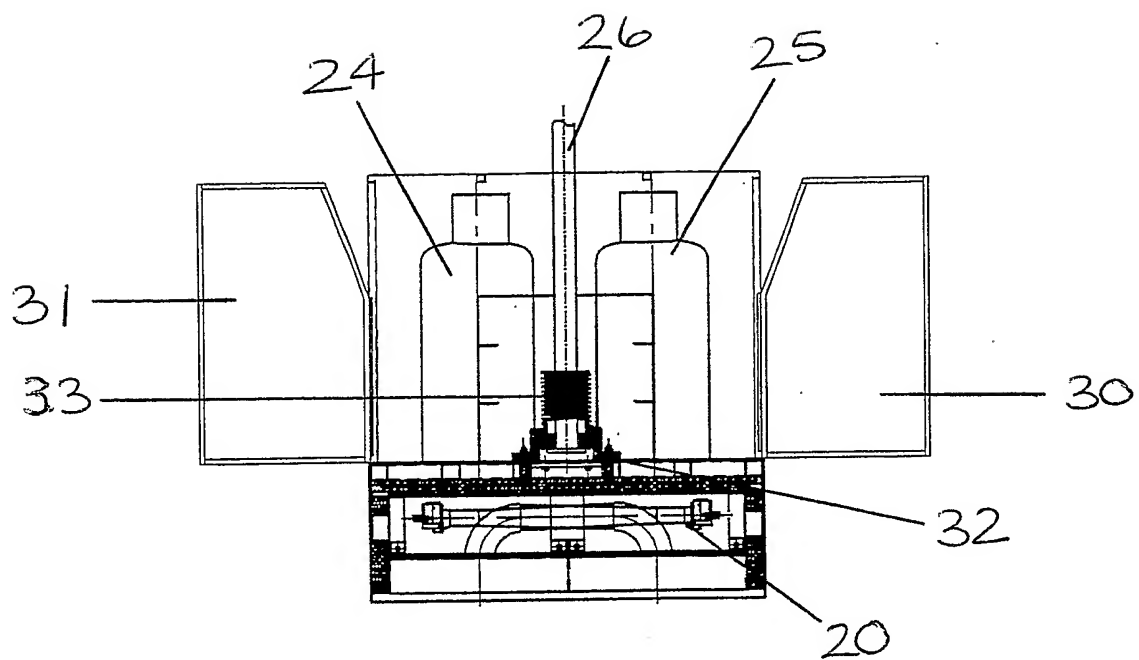


Figure 8

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 03/09144

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E01C23/06 E01C23/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 E01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 791 814 A (WILEY PATRICK C) 11 August 1998 (1998-08-11)	1,2
Y	column 9, line 9 -column 9, line 13 column 9, line 48 -column 10, line 54 figures 1,2 ---	3,4,6, 8-10,13, 14
Y	US 3 625 489 A (WEAVER ARTHUR JAMES) 7 December 1971 (1971-12-07) column 1, line 20 -column 1, line 26 column 1, line 64 -column 1, line 71 column 2, line 21 -column 2, line 69 figures 1,2,5 --- -/--	3,4,8-10



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

28 November 2003

Date of mailing of the international search report

04/12/2003

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Hendrickx, X

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 03/09144

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 944 632 A (DILLINGHAM HAROLD W) 31 July 1990 (1990-07-31) column 2; line 51 -column 2, line 53 column 3, line 19 -column 3, line 41 claim 12 figures 1,2 ----	6
Y	US 3 989 401 A (MOENCH FRANK F) 2 November 1976 (1976-11-02) column 1, line 52 -column 1, line 59 figures 1,12 ----	13,14
X	US 5 653 552 A (WILEY PATRICK C ET AL) 5 August 1997 (1997-08-05) column 1, line 58 -column 2, line 23 column 6, line 15 -column 6, line 33 column 7, line 49 -column 7, line 62 column 8, line 35 -column 8, line 60 figure 2 ----	16
Y	WO 00 20689 A (ASPHALT SYSTEMS INTERNATIONAL ;GOODHART JONATHAN LUKE HENRY (GB);) 13 April 2000 (2000-04-13) cited in the application page 4, line 29 -page 4, line 30 page 5, line 9 -page 5, line 11 page 7, line 19 -page 8, line 10 page 10, line 1 -page 10, line 3 ----	17-20
Y	US 5 419 654 A (KLEIGER SCOTT P) 30 May 1995 (1995-05-30) column 9, line 51 -column 10, line 17 figures 1,6A,6B ----	17-20
A	US 5 419 654 A (KLEIGER SCOTT P) 30 May 1995 (1995-05-30) column 9, line 51 -column 10, line 17 figures 1,6A,6B ----	5,12
A	US 3 625 120 A (NAGY JOSEPH) 7 December 1971 (1971-12-07) column 3, line 16 -column 3, line 24 figures 1,2 ----	7
A	US 3 270 632 A (SCHULTZ DONALD L) 6 September 1966 (1966-09-06) figures 1-3 ----	9-11
A	US 6 227 762 B1 (VAN VELSOR WESLEY) 8 May 2001 (2001-05-08) claim 6; figures 1-6 ----	11-14
A	US 4 252 487 A (JEPPSON MORRIS R) 24 February 1981 (1981-02-24) column 5, line 63 -column 6, line 29 figures 2,4A,4B ----	16
A	EP 0 149 848 A (SOAVE ASFALTI) 31 July 1985 (1985-07-31) page 10, line 14 -page 10, line 19 -----	16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 03/09144

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5791814	A	11-08-1998	CA 2061682 A1 AT 184343 T AU 3489493 A BR 9305943 A WO 9317185 A1 CN 1076749 A ,B CZ 9402009 A3 DE 69326326 D1 DE 69326326 T2 DK 628110 T3 EP 0628110 A1 ES 2139003 T3 GR 3032094 T3 HU 67616 A2 JP 3293626 B2 JP 7506160 T KR 275052 B1 MX 9300928 A1 NZ 249074 A PL 174227 B1 RU 2121031 C1 US 5472292 A	22-08-1993 15-09-1999 13-09-1993 21-10-1997 02-09-1993 29-09-1993 15-11-1995 14-10-1999 18-05-2000 03-04-2000 14-12-1994 01-02-2000 31-03-2000 28-04-1995 17-06-2002 06-07-1995 15-12-2000 31-08-1994 24-04-1997 30-06-1998 27-10-1998 05-12-1995
US 3625489	A	07-12-1971	NONE	
US 4944632	A	31-07-1990	NONE	
US 3989401	A	02-11-1976	CA 1093365 A1 CA 1087011 A2	13-01-1981 07-10-1980
US 5653552	A	05-08-1997	CA 2102090 A1 AT 183790 T AU 7988294 A WO 9512033 A1 DE 69420279 D1 EP 0726983 A1	30-04-1995 15-09-1999 22-05-1995 04-05-1995 30-09-1999 21-08-1996
WO 0020689	A	13-04-2000	AU 1285800 A CA 2352669 A1 CN 1333852 T EP 1133600 A1 GB 2345714 A ,B GB 2352750 A ,B WO 0020689 A1 JP 2002526696 T	26-04-2000 13-04-2000 30-01-2002 19-09-2001 19-07-2000 07-02-2001 13-04-2000 20-08-2002
US 5419654	A	30-05-1995	NONE	
US 3625120	A	07-12-1971	NONE	
US 3270632	A	06-09-1966	NONE	
US 6227762	B1	08-05-2001	NONE	
US 4252487	A	24-02-1981	CA 1117342 A1 DE 2926468 A1 GB 2024291 A ,B JP 1410734 C	02-02-1982 10-01-1980 09-01-1980 24-11-1987

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 03/09144

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4252487 A		JP 55013396 A	30-01-1980
		JP 62013442 B	26-03-1987
EP 0149848 A	31-07-1985	IT 1181498 B	30-09-1987
		AT 54689 T	15-08-1990
		DE 3482758 D1	23-08-1990
		EP 0149848 A2	31-07-1985